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COMPLETE SPECIFICATION

Fuel Composition

We, N.V. DE BATAAFSCHE PETROLEUM
MAATSCHAPPIJ, a Company organised under
the laws of The Netherlands, of 30 Carel van
Bylandtlaan, The Hague, The Netherlands,
do hereby declare the invention, for which
we pray that a patent may be granted to us,
and the method by which it is to be performed,
to be particularly described in and by the
following statement:—

This invention relates to improved fuel
compositions, particularly for use in aircraft
engines, more particularly in turbo jet engines.

Generally it is desirable to use fuels having a
high heat of combustion both on a volume and
a weight basis in jet aircraft because the ranges
of such aircraft are increased as the fuels used
have higher heats of combustion. In this con-
nection the physical properties of some types
of hydrocarbons have been investigated insofar
as their heats of combustion per unit weight
and per unit volume are concerned. These
investigations have led to the following con-
clusions.

Aromatic hydrocarbons are undesirable for
use as fuels in jet aircraft since they have too
low a heat of combustion per unit weight and
also poor burning properties. Paraffins are
unsuitable for use as fuels because of their low
density and consequently, their low heat of
combustion per unit volume. Alkyl mono-
cyclic alkanes are somewhat better than
paraffins, but when the alkyl side chains are of
sufficient length they show paraffin properties.
It is not desirable to use olefins (especially
straight-chain olefins) in aircraft since they
may be oxidized and polymerized under the
conditions of use. Some cyclic olefinic struc-
tures may merit consideration when they are
intended to be used together with an inhibitor
against oxidation. A certain group of hydro-
carbons containing at least two carbocyclic
rings shows advantageous fuel characteristics.
The polycyclic hydrocarbons having 3 or more
rings and less than 3 double bonds per molecule
exhibit extremely high heats of combustion

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per unit volume. However, such compounds
have a relatively low heat of combustion per
unit weight. Moreover, these compounds are
frequently crystalline substances so that they
are not suitable for use per se as fuels in air-
craft since they will block up the passages of
the fuel injection system. The same applies to
many bicyclic hydrocarbons.

It is known that numerous petroleum
refinery streams contain varying amounts of
aromatics and among these are sources con-
taining polycyclic aromatics. These streams can
be hydrogenated in order to obtain improved
fuel types containing polycyclic naphthenes.
Without extensive processing, however, it is
difficult and usually impossible by the use of
previous methods to obtain satisfactory fuels
of high heat of combustion on both a weight
and a volume basis since these streams nor-
mally contain substantial proportions of hydro-
carbons having reduced heating value either
per unit volume or per unit weight.

In the case where monocyclic-aromatics
such as xylenes and toluenes or benzene are
pyrolyzed in order to obtain diphenyl struc-
tures, the resulting pyrolysis products then
being hydrogenated, the products obtained
may have a relatively high heat of combustion
on a weight basis, but have a low heat of
combustion on a volume basis.

It has been found that the admixture of
certain types of hydrocarbons forms a fuel
composition having an optimum heat of com-
bustion both on weight and on volume basis
and a low pour point.

According to the invention, the composition
comprises between 10% and 90% by weight
of a component A, namely, a hydrocarbon or
a mixture of hydrocarbons having not more
than 2 double bonds per molecule and not
more than 2 carbocyclic rings per molecule,
together with between 10% and 90% by weight
of a component B, namely a polycyclic hydro-
carbon or a mixture of polycyclic hydrocarbons
having not more than 3 double bonds per

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molecule and having 3 to 6 carbocyclic rings per molecule, said composition boiling within the combined gasoline-kerosene-gas oil range. The admixture of between 15% and 75% by weight of component A together with between 25% and 85% by weight of component B is preferred.

The nomenclature used herein for describing and identifying hydrocarbons is that proposed or recognized by Patterson and Capell ("The Ring Index", A.C.S. Monograph No. 84, Reinhold Publishing Company, 1940). In some cases, however, trivial names are used as being simpler or more descriptive.

Normal paraffins and the JP-4 fuels possess relatively low heat of combustion per unit volume but at the same time possess a relatively satisfactory heat of combustion per unit weight. Compounds which contain 2 carbocyclic rings and wherein the carbocyclic rings are either saturated or contain not more than 2 double bonds per molecule, e.g. cis and trans decalins, (1,2,2) bicycloheptane and (1,2,2) bicycloheptadiene, possess only moderately effective thermal properties and according to the present invention such compounds are admixed with polycyclic hydrocarbons having higher heats of combustion per unit volume, e.g. di-methano decalin, dimethano dihydro naphthalene, trimethano perhydro anthracene and bismortricyclene.

The present invention comprises admixing the polycyclic hydrocarbons having 3-6 carbocyclic rings per molecule and not more than 3 double bonds per molecule with hydrocarbons of less desirable heat of combustion per unit volume but which are otherwise suitable for use as fuel components, and particularly those having 1 or 2 carbocyclic rings and not more than 2 double bonds per molecule. Preferably the bicyclic and polycyclic hydrocarbons of the structures defined hereinabove are admixed so as to give fuel compositions having a heat of combustion of at least 9380 kcal/l and at least 10,222 kcal/kg. The higher the heats of combustion are, the better the fuel.

The bicyclic hydrocarbons which constitute one of the blending agents for the present composition may be prepared from petroleum refinery sources and particularly from thermally or catalytically cracked gas oil. Such streams contain bicyclic naphthenic and aromatic hydrocarbons combined with less desirable types of materials. The latter can be minimized, such as by extraction of the feed with a selective solvent, so as to isolate the desired stock for later hydrogenation of the aromatics. If heat of combustion requirements are not extreme, aromatics may remain, as long as the proportion of non-polycyclic hydrocarbons within the desired boiling range of motor fuels is not more than 20% and preferably is less than 10%.

The stocks may then be hydrogenated, the

process for hydrogenation being dependent upon the difficulty with which the particular hydrogenation stock can be substantially saturated and also upon the sulphur content of the basic stock. In most cases, since the hydrogenation feed material is derived from petroleum sources, the stock will contain substantial proportions (i.e. sufficient to poison many sulphur-sensitive catalysts) of sulphur compounds which must be removed insofar as possible prior to complete hydrogenation of the stock. This may be effected by known means using a "sulphur-resistant catalyst", which comprises those catalysts retaining their hydrogenating activity even in the presence of substantial quantities of sulphur or sulphur compounds. Particularly active catalysts of the sulphur-resistant type comprise the oxides or sulphides of metals of the sixth group of the periodic table, either alone or in admixture with oxides or sulphides of metals of the second group and/or eighth group of the periodic table. Sulphides of metals of the eighth group of the periodic system are also active hydrogenation catalysts of the sulphur-resistant type. Examples of the especially active catalysts of this type are mixtures of molybdenum oxide, zinc oxide, and magnesium oxide; molybdenum sulphides; tungsten sulphides supported on activated clay; or iron sulphides supported on activated bentonitic clay.

The temperatures employed for this first stage of hydrogenation are preferably between 315 and 485°C, pressures being within the range of 50-285 kg/cm²; a feed rate of liquid oil to reactor being between 0.5 and 4 parts by volume of oil per unit volume of catalyst per hour, and from 280 to 5600 m³ of hydrogen, measured at standard conditions per m³ of oil.

The product resulting in this first stage of hydrogenation has substantially all of its sulphur content removed and the aromatic content reduced approximately 40-70% due to hydrogenation of the aromatics to form the corresponding naphthenes. Insofar as any olefins are present in the original feed stock these are usually substantially saturated at the end of this first stage of hydrogenation.

The heat of combustion per unit volume of the product obtained by the hydrogenation in the stage described above is higher than that of the original aromatics. However, the product can be further improved in respect of the heat of combustion per unit volume by subjecting the product obtained to a further hydrogenation. In this second stage of hydrogenation a more active (usually sulphur-sensitive) catalyst and lower temperatures may be applied so that hydrogenation of the material may be substantially complete or at least such that not more than 10% by weight of the aromatics remain in the final product. This second stage of hydrogenation may be carried out with the

same type of catalyst but it is preferred that a more active catalyst be employed. Such active catalysts include especially those of a sulphur-sensitive type such as metallic nickel, platinum, palladium, cobalt or iron preferably deposited on aluminium silicate, silica, silica-magnesia, alumina clays of the bentonitic and montmorillonitic type. The quantity of metal in the catalyst may be between 1 and 15% by weight and preferably between 4 and 10% by weight. The conditions of the second stage of hydrogenation include a lower temperature range preferably between 145 and 375°C under pressure of 35—352 kg/cm². Gas rates may be in the order of 280—2800 m³ of hydrogen, measured at standard conditions per m³ of the oil feed while the oil feed rate is in the range from 0.5 to 4 parts by volume of feed per unit volume of catalyst per hour.

The product resulting from these two stages of hydrogenation (each of which may involve one or more cycles through a particular hydrogenation zone and under the particular hydrogenation conditions) comprise substantially bicyclic naphthenes and minor amounts of bicycloalkanes, the proportion of paraffins or isoparaffins being of a minor order, less than about 20% by weight of the final product. Aromatics and olefinic materials are substantially absent therefrom. The bicyclic hydrocarbons may be obtained from this product by distillation to yield a fraction having a boiling range within the limits from 160 to 320°C, preferably from 170 to 300°C.

Suitable material for component A may be prepared by fractionally distilling an aromatic petroleum gas oil to obtain a fraction having a boiling range between 175°C and 375°C, isolating an aromatic concentrate from this fraction and subjecting this concentrate to hydrogenation as previously described.

The bicyclic hydrocarbons may also be obtained, for example, in the following manner. A petroleum crude oil is subjected to fractionation in order to obtain a straight run residue. This is passed to a flash distillation unit to remove volatile constituents and the bottom product from this operation is then sent to recovery elsewhere. The volatile products are sent to a catalytic cracking unit and the product from said cracker are then fractionated, for example, in a distillation column. The heavy catalytically cracked gas oil fraction from this column is conducted to a thermal cracking unit and the thermally cracked residue is then sent to a coking unit. The cycle gas oil from this coking unit constitutes the preferred starting material for use in the preparation of a product which is an essentially saturated bicyclic hydrocarbon mixture also containing minor proportions of dicyclohexyl alkanes. It is preferred practice to then isolate the aromatic proportion of this starting material from the feed such as by treatment with a solvent for aromatics in order to eliminate non-aro-

omatics which have lower heating values. This can be done, for example, by treatment with aniline, sulphur dioxide, nitrobenzene, or furfural and may be by means of vapour-liquid or liquid-liquid extraction for example according to the Clorex, Duosol, or Edlecanu methods or other known extraction procedures. The aromatics thus isolated are then preferably distilled in order to eliminate monocyclic-aromatic materials and so as to obtain a feed material to the hydrogenation units, preferably having a boiling range between 200 and 345°C. This feed material is then hydrogenated by the two-stage hydrogenation process previously described.

The bicyclo alkanes mentioned in Table I may be used either in place of or in addition to the product derived from the petroleum source in accordance with the process described above. These bicyclo-alkanes may be modified by replacement of hydrogen atoms with alkyl radicals as long as the alkyl radicals are less than 6 carbon atoms each in length and preferably less than 3 carbon atoms each.

TABLE I

Bicyclo(1,1,0)butane	Bicyclo(3,2,1)octane	90
Spiropentane	Bicyclo(4,3,0)nonane	
Bicyclo(2,1,0)pentane	Spiro(4,5)decane	
Bicyclo(3,1,0)hexane	Bicyclo(4,4,0)decane (decalin)	95
Spiro(2,4)heptane	Bicyclo(2,2,0)hexane	
Bicyclo(4,1,0)heptane	Spiro(3,3)heptane	
Bicyclo(2,2,1)heptane	Bicyclo(3,2,0)heptane	
Spiro(2,5)octane	Spiro(3,4)octane	
Bicyclo(3,1,1)heptane		100

Table II gives a list of typical dicyclohexyl alkanes which may be used together with the polycyclic hydrocarbons having 3—6 carbocyclic rings per molecule and not more than 3 double bonds per molecule. They may be used in place of or in addition to the bicyclic hydrocarbons of the type described above.

TABLE II

<i>Dicyclohexyl Alkanes</i>	
Dicyclohexyl methane	110
Dicyclohexyl ethane-1,1	
Dicyclohexyl ethane-1,2	
Dicyclohexyl propane-1,1	
Dicyclohexyl propane-1,2	
Dicyclohexyl propane-1,3	115
Dicyclohexyl propane-2,2	
Dicyclohexyl butane-1,4	
Dicyclohexyl butane-2,3	
Dicyclohexyl hexane-1,6	
Dicyclohexyl hexane-2,4	120

Also the alkyl dicyclo hexyl compounds may be used which have 1—3 alkyl radicals in the 2-position attached to one or both of the cyclohexyl radicals, each alkyl radical having 1—3 carbon atoms (especially isopropyl radicals).

In accordance with the present invention, the above types of hydrocarbons having 2 carbocyclic rings either derived from petroleum sources or directly synthesized are admixed with between 10% and 90% by weight based

on the total fuel composition of the described classes of polycyclic hydrocarbons containing from 3 to 6 carbocyclic rings per molecule and not more than 3 double bonds per molecule.

5 While such materials may be obtained from natural sources such as petroleum or coal tar by special fractionation procedures, it is preferred that they be synthesized directly even though this may cause an increase in the cost of material. For example, a typical preparation 10 comprises the addition of acetylene to cyclopentadiene to form 1,4-methano cyclohexadiene, which upon hydrogenation yields 1,4-methano cyclohexane. If 1,4-methano cyclohexadiene is caused to react with cyclopentadiene, the resulting product is dimethano 15 dihydronaphthalene. This, in turn, can be hydrogenated to produce dimethano decalin. This reaction may be repeated with the addition of cyclopentadiene to dimethano dihydronaphthalene to yield trimethano tetrahydroanthracene.

Consequently, it will be seen that there are readily available methods for the production of 25 polycyclic hydrocarbons and particularly those containing at least one endocyclic ring. Typical polycyclic hydrocarbons which may be used as the second major component of the subject fuel compositions are listed in Table III, it being 30 understood that the nuclei listed in this table may, if desired, be modified by substitution of hydrogen atoms with alkyl radicals having less than 6 and preferably less than 5 carbon atoms each.

TABLE III

35	Spiro bicyclo(2,1,0)pentane
	5,1'-cyclopentane
	Tricyclo(3,2,1,0,2,4)octane
	Hexahydrocyclopentindene
40	Octahydro 1,4-methano-pentalene
	1,4-ethanodecalin
	Trindan

The fuel compositions according to the present invention are primarily designed for operation in aircraft engines and more particularly in 45 turbo jet engines as well as turbo-prop engines. In the operation of turbo jet engines, air is withdrawn from the atmosphere into an air compressor, compressed and delivered to the combustion chamber of the engine where it is 50 mixed with the fuels and the product ignited. The resulting burning mixture of fuel and air is diluted with secondary air and expanded through a turbine which drives the air compressor. In these engines, the hot mixture is 55 expanded in the turbine in such a manner that only sufficient energy is extracted from the gases to operate the compressor. The remaining energy is employed to eject the gases in jet 60 form through a jet pipe into the atmospheres and thereby producing thrust.

In using these fuels in turbo-prop engines, the operation is essentially the same except that the gases are almost completely expanded in

the turbine, i.e., they are expanded almost 65 down to the pressure of the surrounding atmosphere, leaving only a relatively small amount of energy to produce thrust when ejected through the jet pipe. Thus, in turbo-prop engines, the majority of the energy from 70 the hot expanding gases is used to operate the compressor and the propeller and hence, the thrust is obtained primarily from the latter.

In many turbo-prop engines, only a single 75 stage turbine is employed. However, more than a single stage may be employed and if so guide vanes are introduced between turbine wheels. After leaving the last turbine, the gas enters the jet pipe and is discharged therefrom in the 80 atmosphere.

The fuels of the present invention may be used advantageously in the spark ignition piston type air-craft engine, diesel engines and turbine engines generally, but are particularly suitable 85 for use in ram jet, turbo jet and turbo-prop aircraft engines.

In this connection it is to be noted that the fuel compositions of the present invention have a low pour point falling within the ordinary 90 pour point range for fuels useful in aircraft engines, although some of their components, particularly those containing more than 2 carbocyclic rings per molecule, are either solids or have relatively high pour points when they 95 are not combined with the hydrocarbons containing not more than 2 carbocyclic rings.

The following example is illustrative of the present invention:

EXAMPLE

By blending various proportions of dimethano-dihydronaphthalene with decalin comprising about equal proportions of the cis and trans isomers of decalin, fuels can be produced 100 having heats of combustion on a volume basis between 9000 kcal/l and 10320 kcal/l while the corresponding heats of combustion on a weight basis are reduced only from 10150 kcal/kg to 9983 kcal/kg. Specifically, a blend of 25% 105 by weight cis-decalin, 25% trans decalin, and 50% dimethanodihydronaphthalene was a heat of combustion on a volume basis of 9621 kcal/l and on a weight basis of 10056 kcal/kg.

By blending the saturated counterpart of dimethanodihydronaphthalene, that is dimethanodecalin, in the proportion of 34.5% by 115 weight with 65.5% of 2-iso-propylbicyclohexyl, the weight heating value of JP-4, that is 10222 kcal/kg, can be maintained while a volume heating value of 9608 kcal/l can be achieved. 120 By using 33% by weight of the 2-isopropylbicyclohexyl and 67% of binortricyclene, the 10222 kcal/kg level can be maintained while achieving 10499 kcal/l heating value.

The following Table IV illustrates further 125 blends coming within the scope of this invention, the first seven fuel compositions being included merely by way of comparison.

TABLE IV

	Paraffin C ₁₂	DCHP	Kerosene	Cis Decalin	DMD	TMPHA	BNTC	Heat of Combustion	
								kcal/kg	kcal/l
Neat	100%	100%	100%	100%	100%	100%	100%	10566	8107
Neat	...	...	...	...	...	...	...	10347	9065
Neat	...	...	...	...	...	...	...	10331	8375
Neat	...	...	...	...	...	...	...	10155	9125
Neat	...	...	...	...	...	...	...	10004	10151
Neat	...	...	...	...	...	...	...	10111	11256
Neat	...	...	...	...	...	...	...	10167	11323
Blends—wt %									
Mixture of isomeric dodecanes and di-									
methanodecalins	39.5	—	—	—	60.5	—	—	10233	9179
Mixture of isomeric dodecanes and di-	31.6	—	—	—	68.4	—	—	10184	9380
methanodecalins									
Mixture of isomeric dodecanes and tri-	24.7	—	—	—	—	75.3	—	10222	10251
methanoperhydroanthracene									
Mixture of isomeric dodecanes and tri-	51.4	—	—	—	—	48.6	—	10339	9380
methanoperhydroanthracene									
Mixture of isomeric dodecanes and di-									
methano decalins and trimethanoper-	37.0	—	—	—	48.2	14.8	—	10222	9380
hydroanthracene									
Mixture of isomeric dodecanes and di-									
methano decalins and trimethanoper-	32.5	—	—	—	32.0	35.5	—	10222	9715
hydroanthracene									
Mixture of isomeric dodecanes and di-									
methanodecalins and trimethanoper-	43.8	—	—	—	26.7	29.5	—	10289	9380
hydroanthracene									
Mixture of isomeric dodecanes and bi-	52	—	—	—	—	—	48	10372	9380
nortricyclene									
Mixture of isomeric dodecanes and bi-	14	—	—	—	—	—	86	10222	10787
nortricyclene									
Mixture of isomeric dodecanes and bi-	36	—	—	—	51.4	—	12.6	10222	9380
nortricyclene and dimethanodecalins									
Mixture of isomeric dodecanes and tri-									
methanoperhydroanthracene and de-	22.5	—	—	48.0	—	29.5	—	10222	9380
calin (cis)									

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TABLE IV (continued)

	Paraffin C ₁₂	DCHP	Kerosene	Cis Decalin	DMD	TMPHA	BNTC	Heat of combustion	
								kcal/kg	kcal/l
Dicyclohexylpropane-1,3 and dimethanodecalins	—	63.5	—	—	36.5	—	—	10222	9380
Dicyclohexylpropane-1,3 and trimethanoperhydroanthracene	—	82.6	—	—	—	17.4	—	10306	9380
Dicyclohexylpropane-1,3 and trimethanoperhydroanthracene	—	46.5	—	—	—	53.5	—	10222	10184
Dicyclohexylpropane-1,3 and trimethanoperhydroanthracene and dimethanodecalins	—	77.7	—	—	11.0	11.3	—	10284	9380
Dicyclohexylpropane-1,3 and trimethanoperhydroanthracene and dimethanodecalins	—	57.0	—	—	21.2	21.8	—	10222	9715
Dicyclohexylpropane-1,3 and binortricyclene	—	84.0	—	—	—	—	16.0	10317	9380
Dicyclohexylpropane-1,3 and binortricyclene	—	69.0	—	—	—	—	31.0	10222	10519
Dicyclohexylpropane-1,3 and decalin and trimethanoperhydroanthracene	—	40.0	—	60.0	—	—	—	10222	9112
WR640 and decalin	—	42.0	—	43.0	—	15.0	—	10222	9380
WR640 and dimethanodecalins	—	—	43.5	56.5	—	—	—	10222	8777
WR640 and trimethanoperhydroanthracene	—	—	65.5	—	34.5	—	—	10222	8911
WR640 and binortricyclene	—	—	50.0	—	—	50.0	—	10222	9581
WR640 and binortricyclene	—	—	33.5	—	—	—	66.5	10222	10184
WR640 and dimethanodecalins and trimethanoperhydroanthracene	—	—	59.5	—	—	—	40.5	10266	9380
WR640 and dimethanodecalins and binortricyclene	—	—	55.6	—	10.5	33.9	—	10222	9380
WR640 and dimethanodecalins and binortricyclene	—	—	48.0	15.7	—	36.3	—	10222	9380
WR640 and decalins and binortricyclene	—	—	53.5	—	13.5	—	33.0	10222	9380
WR640 and decalins and binortricyclene	—	—	38.5	31.4	—	—	30.1	10222	9380

C₁₂—Hydrog. Propylene Tetramer WR640 Kerosene—Kerosene Fuel for Commercial Jets DMD—Dimethano Decalin BNTC—Binortricyclene
DCHP—Dicyclohexyl propane, 1-3 Decalin—Cis was used TMPHA—Trimethano perhydroanthracene

WHAT WE CLAIM IS:—

1. A fuel composition which comprises between 10% and 90% by weight of a component A, namely, a hydrocarbon or a mixture of hydrocarbons having not more than 2 double bonds per molecule and not more than 2 carbocyclic rings per molecule together with between 10% and 90% by weight of a component B, namely a poly-cyclic hydrocarbon or a mixture of poly-cyclic hydrocarbons having not more than 3 double bonds per molecule and having 3 to 6 carbocyclic rings per molecule, said composition boiling within the combined gasoline-kerosene-gas oil range.
2. A fuel composition as claimed in claim 1, in which the component A is present in a proportion between 15% and 75% by weight and the component B is present in a proportion between 25% and 85% by weight.
3. A fuel composition as claimed in claim 1 or 2, in which the component A is or contains a bicyclic hydrocarbon or a mixture of bicyclic hydrocarbons.
4. A fuel composition as claimed in any one of claims 1 to 3 in which the component A is prepared by isolating an aromatic concentrate from a gas oil, subjecting this concentrate to desulphurizing hydrogenation at an elevated temperature, subjecting the product so obtained to a second hydrogenation at a lower temperature until the aromatic content of the product is reduced below 10% by weight and fractionally distilling the hydrogenated product to obtain a fraction boiling within the range of from 160°C to 320°C.
5. A fuel composition as claimed in any one of claims 1 to 3, in which the component A is prepared by fractionally distilling an aromatic petroleum gas oil to obtain a fraction having a boiling range between 175°C and 375°C, isolating an aromatic concentrate from this fraction, subjecting this concentrate to desulphurizing hydrogenation at an elevated temperature, subjecting the product so obtained to a second hydrogenation at a lower temperature until the aromatic content of the product is reduced below 10% by weight and fractionally distilling the hydrogenated product to obtain a fraction boiling within the range of from 160°C to 320°C.
6. A fuel composition as claimed in claims 4 and 5 in which the component A is prepared from a thermally or catalytically cracked gas oil.
7. A fuel composition as claimed in claims 4 to 6, in which the component A is prepared from a gas oil obtained by coking a residue from a catalytically or thermally cracking operation.
8. A fuel composition as claimed in any one of the claims 4 to 7, wherein the gas oil is distilled to obtain a fraction boiling within the range of 200—345°C.
9. A fuel composition as claimed in any one of claims 4 to 8, wherein the aromatic concentrate is isolated from the gas oil fraction by solvent extraction.
10. A fuel composition as claimed in any one of claims 4 to 9, wherein the desulphurizing hydrogenation of the aromatic concentrate is carried out in the presence of a sulphur-resistant catalyst which is an oxide or a sulphide of a metal of the sixth group of the periodic system, either alone or in admixture with an oxide or a sulphide of a metal of the second and/or eighth group of the periodic system.
11. A fuel composition as claimed in any one of claims 4 to 9, wherein the desulphurizing hydrogenation of the aromatic concentrate is carried out in the presence of a sulphur-resistant catalyst which is a sulphide of a metal of the eighth group of the periodic system.
12. A fuel composition as claimed in claim 10, wherein the sulphur-resistant catalyst is a mixture of molybdenum oxide, zinc oxide and magnesium oxide.
13. A fuel composition as claimed in claim 10, wherein the sulphur-resistant catalyst is molybdenum sulphide.
14. A fuel composition as claimed in claim 10, wherein the sulphur-resistant catalyst is a tungsten sulphide supported on activated clay.
15. A fuel composition as claimed in claim 11, wherein the sulphur-resistant catalyst is an iron sulphide supported on activated bentonitic clay.
16. A fuel composition as claimed in any one of claims 4—15, wherein the desulphurizing hydrogenation is carried out at temperatures between 315 and 485°C.
17. A fuel composition as claimed in any one of claims 4—16, wherein the desulphurizing hydrogenation is carried out at pressures within the range of 50—285 kg/cm².
18. A fuel composition as claimed in any one of claims 4—17, wherein the feed rate of the aromatic concentrate to the desulphurizing hydrogenation unit is between 0.5 and 4 parts by volume of the concentrate per unit volume of catalyst per hour.
19. A fuel composition as claimed in any one of claims 4—18, wherein the feed rate of hydrogen is between 280 and 5600 m³, measured at standard conditions, per m³ of the concentrate.
20. A fuel composition as claimed in any one of claims 4—19, wherein the second hydrogenation step is carried out in the presence of a sulphur-sensitive catalyst which is a metal or an oxide of a metal of the eighth group of the periodic system.
21. A fuel composition as claimed in claim 20, wherein the sulphur-sensitive catalyst is metallic nickel, platinum, palladium, cobalt or iron deposited on aluminium silicate, silica or alumina clays of the bentonitic and montmorillonitic type.
22. A fuel composition as claimed in claim 20 or 21, wherein the amount of metal in the catalyst is between 1 and 15% by weight,

- preferably between 4 and 10% by weight.
23. A fuel composition as claimed in any one of claims 4—22, wherein the second hydrogenation step is carried out at temperatures between 145 and 375°C.
24. A fuel composition as claimed in any one of claims 4—23, wherein the second hydrogenation step is carried out at pressures between 35 and 352 kg/cm².
25. A fuel composition as claimed in any one of claims 4—24, wherein the feed rate of hydrogen in the second stage of hydrogenation is between 280 and 2800 m³, measured at standard conditions per m³ of the oil feed.
26. A fuel composition as claimed in any one of claims 4—25, wherein the oil feed rate during the second stage of hydrogenation is between 0.5 and 4 parts by volume per unit volume of catalyst per hour.
27. A fuel composition as claimed in any one of claims 4—26, wherein the hydrogenated product is fractionally distilled to obtain a fraction boiling within a range of from 170 to 300°C.
28. A fuel composition as claimed in any one of claims 1 to 3, in which the component A is or contains a bicycloalkane or a mixture of bicycloalkanes.
29. A fuel composition as claimed in claim 28, in which the bicycloalkane(s) has(have) at least one alkyl radical containing less than 6 carbon atoms, preferably less than 3 carbon atoms.
30. A fuel composition as claimed in any one of claims 1 to 3, in which the component A is or contains a dicyclohexyl alkane or a mixture of dicyclohexyl alkanes.
31. A fuel composition as claimed in claim 30, in which the dicycloalkane(s) has(have) 1—3 alkyl radicals in the 2-position attached to one or both of the cyclo hexyl radicals, each alkyl radicals having 1—3 carbon atoms.
32. A fuel composition as claimed in any one of claims 1 to 31, in which the component B is a polycyclic hydrocarbon or a mixture of polycyclic hydrocarbons containing at least one endocyclic ring.
33. A fuel composition as claimed in claim 32, in which the component B is prepared by adding acetylene to cyclopentadiene to form 1,4-methanocyclohexadiene and hydrogenating this compound to obtain 1,4-methano cyclohexane.
34. A fuel composition as claimed in claim 32, in which the component B is prepared by reacting 1,4-methano cyclohexadiene with cyclopentadiene to form dimethano dihydronaphthalene.
35. A fuel composition as claimed in claim 32, in which dimethano dihydronaphthalene is hydrogenated to produce dimethano decalin.
36. A fuel composition as claimed in claim 32, in which the component B is prepared by reacting cyclopentadiene with dimethano dihydronaphthalene to yield trimethano tetrahydroanthracene.
37. A fuel composition as claimed in any one of claims 1 to 31, in which the component B is or contains a polycyclic hydrocarbon or a mixture of polycyclic hydrocarbons containing at least one alkyl radical with less than 6 and preferably less than 5 carbon atoms.
38. A fuel composition as claimed in any of the preceding claims substantially as hereinbefore described.

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